The Realities of Blockchain-Based New Public Governance: An Explorative Analysis of Blockchain Implementations in Europe

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Blockchain technology and New Public Governance (NPG) represent promising concepts for various researchers. As such, both concepts offer the vision of an altered relationship between public administration and its non-public actors by emphasizing a strong position of non-public actors for public service delivery. This research aims to identify the relevance of NPG to leading blockchain implementations in the European public sector. For this purpose, both topics are combined in an explorative analysis. The analysis leverages an adapted analysis framework designed for this research effort to structure the expectations around NPG. Qualitative interviews with multiple key stakeholders of blockchain implementations projects were conducted to understand the actual impact of blockchain on the actor's relationships for public service delivery. This article presents the findings to this question and concludes that the use of blockchain has changed actor relationships only in parts. Consequently, the author finally draws attention to the importance of blockchain governance and blockchain regulation for further developing the relationships of public administrations and their non-public counterparts.

CCS Concepts: • **Computer systems organization** → **Distributed architectures**; • **Applied computing** → *E-government*;

Additional Key Words and Phrases: Empirical analysis, expectation framework, blockchain projects, blockchain governance

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1 INTRODUCTION

The development and transformation of **public administrations (PAs)** has been an ongoing topic among researchers for decades [1, 2]. These discussions continue as changing political, societal, and economic challenges demand constant reflection on the way PAs are set up. In terms of dealing with these challenges, the reform paradigm of **New Public Governance (NPG)** is widely perceived as delivering new perspectives on the fundamental development of PAs. It demonstrates a shift toward collaborative forms of interaction between various actors and therefore places a great deal of focus on governance [3, 4].

Information technology is already supporting transformative efforts within the public sector [5], such as to enable participative governance [6, 7] or drive the exchange between public and non-public actors [8]. Distributed

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ledger technologies, the new technology of blockchain in particular, are said to facilitate this exchange by questioning the fundamentals of PA [9]. It raises both hopes and questions among scholars and practitioners alike, leading to a number of activities designed to improve the understanding of its impact on the public sector.

However, structured and more detailed scientific efforts to assess the institutional implications of the use of blockchain are scarce [10, 11]. This particularly applies to the theoretical question of NPG and to what extent it could benefit from blockchain. As with any other research, it is important to expand and check theoretical work through complementary empirical research. To date, many blockchain projects have been conducted worldwide with the aim of changing the way that public services are delivered. Those projects seek to change a wide range of public services, such as with respect to land title registry, digital identities, or academic credentials [12]. From a scientific standpoint, it is beneficial to evaluate these projects empirically to see whether they are in line with the theoretical discussions on the development of PAs. These insights could provide valuable feedback for further research agendas and may also shape the design of blockchain projects to come.

Consequently, this article focuses on closing this empirical gap. The aim of this research is to conduct a small-N case study to assess whether the functional expectations associated with NPG match with what is actually delivered today. NPG, for example, is expected to provide public services in a co-producing and bilateral manner between various actors. When the outcome of a blockchain project enables this kind of service delivery, it is likely able to support the fulfillment these expectations around NPG.

This article describes these research efforts and results, and is structured as follows. Within Section 2, the foundations of NPG and blockchain are described, and thereby the core elements of NPG are introduced, setting out the basic parameters for the expectations it gives rise to. Section 3 explains the methodological approach in greater detail. This includes the definition of an expectation analysis framework as well as explanations regarding case study selection and questionnaire design. Section 4 combines the outcome from conducted interviews and a corresponding discussion to effectively highlight matching and mismatching expectations. Finally, Section 5 summarizes the major findings with respect to this article's research aim and presents the limitations of this research approach as well as recommendations for further research.

2 BACKGROUND

As outlined, this article seeks empirical evidence that combining NPG and blockchain technology can add value. Hence, this section explains the foundations of both subjects and also introduces the characteristics they possess that are essential for this article.

2.1 New Public Governance

PAs serve a wide range of purposes. They are supporters, regulating and supervising bodies, and counselors, among others [13], for various stakeholders. It is worth noting that actions essentially can affect a varying number of actors ranging from one individual actor to the society as a whole. The latter is crucial in the context of social affairs [14], as many PAs seek a balanced social system by continuously shifting resources between actors. Making decisions on these various matters requires them to be capable of dealing with varying circumstances [15, 16]. Being able to do so implies the ability to manage knowledge, including its availability or accurateness, on alternating levels [15].

Admittedly, this perception is a rather idealistic one; the status quo of PAs is often characterized as inflexible or inefficient [17], as well as insufficiently transparent [18] or increasingly complex [19]. This makes it difficult to overcome challenges such as the individualization of society, globally diffused business models [20], or increasingly complex interactions between PAs.

Public reforms aimed at transforming PAs have been started in various countries. However, reforms in Europe, which represent the scope of this article, mostly relate to the reform approach of New Public Management and thus adhere to a narrowed, intraorganizational perspective [3, 21]. This approach focuses on improving efficiency,

Table 1. Description of NPG Core Elements

NPG Core Element [10]	Description
Voluntary Co-Producing Networks	Public services are delivered in a networking manner by public and non-public actors. The delivery is consensus oriented and can take place without the involvement of PAs. It combines actor capacities collaboratively to jointly deliver public services [3, 14].
Interorganizational Governance	Proper coordination takes place across actors to deliver public services. This includes the alignment of design, execution, and monitoring/evaluation of service delivery [28].
Contracts and Trust-Based Management	Formal and informal procedures are leveraged to coordinate and jointly deliver public services [23].

budget, or quality within the administration [22]. Intraorganizational reforms alone are unlikely to diffuse the dissatisfaction of citizens. This raises the question of how public services should instead be delivered. It would be beneficial to add an interorganizational perspective to the intraorganizational perspective of New Public Management [21]. However, this requirement is rarely fulfilled in practice [23].

Not surprisingly, researchers are challenging the principles of PAs [24, 25], and their interest in bilateral and informal procedures of cooperation, in particular, is constantly increasing [7, 20]. Networks of self-organizing and participating stakeholders are also in the scope of today's research [13, 16]. Consequently, public services provided to and by different stakeholders would require a very different understanding of the management of this kind of service delivery system, establishing a new focus on governance.

Both formal and informal processes are required to allow collaborative interaction between stakeholders and thereby enable this governance-focused paradigm [23]. Such focus on governance is perceived as a further development of public governance and is known as NPG, which aims to improve the efficiency and quality of public services. One important principle of this is collaborative governance, which considers the combination of the capacities of businesses, society, PAs, and the third sector. Actors work together when they are interested in either joint results or joint service delivery [26]. Trust and integrated leadership are also essential principles for this governance paradigm [23].

Pestoff [2] noted that the understanding and composition of actors also changes with the introduction of NPG. With NPG, the traditional and rather economic view, including buyers, contractors, customers, and so on, must be related to civil leadership, partnerships, and networks. The central role that PAs have today would change in a public service delivery system that relies on collaborative governance between multiple actors. PAs would become one out of many [3, 14, 27]. The collaborative delivery of public services by public and non-public actors is consensus oriented and therefore requires adequate incentives for actors to ensure active participation in service delivery [23]. Consequently, mandatory collaboration for public service delivery would weaken the original idea of NPG, which favors consensus among involved actors.

In summary, three core elements of NPG can be identified, as outlined in Table 1. The effectiveness of an NPG-based public service delivery system depends on the degree of coverage of these three core elements. The implementation of these core elements in a PA would most likely require large-scale reorganization.

In the past, **Information and Communication Technology (ICT)** has played an important role in facilitating the reorganization of PAs. ICT could again emerge as a critical success factor for collaboration between PAs and their stakeholders in terms of NPG. In fact, ICT is already enabling participation by citizens and businesses alike [2, 29], such as by opening up data silos to non-public stakeholders. This can be seen as a manifestation of open government, which aims to redefine the interaction between PAs and their stakeholders [30] to ultimately strengthen democratic societies [31]. Some scholars argue, however, that digitalizing the exchange between public and non-public actors has not always fulfilled these promises [32].

2.2 Blockchain

Blockchain is widely perceived as a recent promise to reestablish the relationship between public and non-public actors. With blockchain, actors can reliably exchange various digital assets such as currency, contracts, or access rights. It evolved as one of the distributed ledger technologies, which forms a network of nodes that hosts securely stored data [33]. Software programs, so-called protocols, then conduct transactions in this ledger to fulfill a purpose within a field of application [34]. Whether one can join, read, or write on a blockchain network is dependent on the setup of the blockchain environment. Public blockchains are open to everybody, and no dedicated authorization for users is required. However, users of private blockchain networks need to be granted access by a defined authority [35]. The strength and promise of blockchain result from its key functional characteristics. There is a wide range of characteristics associated with blockchain [33, 36, 37], but on a functional level it comes down to four essential characteristics [37].

The immutability of data, as one key characteristic, ensures that data (e.g., voting results) cannot be changed once they are stored in the blockchain. This is enabled by the combined use of cryptography and the way each block is linked to another block. However, this feature also presents a challenge for data privacy, especially in Europe. The **European General Data Protection Regulation (GDPR)** gives citizens the right to have their data be forgotten [38], which is in opposition to blockchain's unalterable nature. Scholars and practitioners alike are still in the process of finding answers and solutions to this issue.

The second key characteristic concerns the decentralized setup of the blockchain network. Citizens, businesses, or PAs can exchange their data on a peer-to-peer basis [36] (i.e., without an intermediate entity). Thereby, bilateral working modes are the norm. The exchange of data between two users takes place based on predefined procedures.

In addition, the blockchain network is consensus driven. This third characteristic refers to the fact that users have the same understanding of what the shared data is, and thus they agree on its accurateness. It is worth noting that this does not necessarily mean that the data itself is accurate, when false data is being delivered (e.g., by legacy systems). That is why the transition of data from an off-chain to an on-chain environment is critical for the overall acceptance of a blockchain network.

Transparency of data, the fourth key characteristic, is another appealing feature for users. They are able to access the history of all transactions that have ever occurred. This could contribute to public services being trusted and accepted because, for example, decisions made, or rules applied in the making of decisions, could become traceable for all [39]. In particular, smart contracts build on blockchain's transparency and decentralization. This effective tool supports the automated execution of transactions when certain upfront-coded criteria are met [11]. They can be executed as a result of or as a replacement for manual bilateral interaction. Additionally, the code behind smart contracts and thus the underlying rules are transparent to everyone.

Scholars and public and non-public stakeholders around the world are trying to identify what potential this comparatively new blockchain technology may have for their organizations [11]. A large number of projects have been started, partly with the involvement of both public and non-public stakeholders within individual projects. In addition, national or local governments in various countries, such as the United States or within the EU area, are increasing their efforts to regulate and legislate for blockchain. These governments are focusing their attention on cryptocurrencies (including Initial Coin Offerings), crypto tokens, and smart contracts [40].

In addition, many scholars continue to focus on cryptocurrencies [16]. The fields of application, however, reach way beyond financials [39]. Atzori [16] and Ølnes et al. [11] acknowledge, among other points, a lack of attention being paid to issues of governance. Generally speaking, governance concerns the process of decision making, including the definition of the decisions to be made and the accountability for them [14, 41]. This is critical within the domain of PA and NPG, particularly when blockchain enthusiasts argue in favor of a self-organizing society that functions via blockchain [16]. Approaches to blockchain governance are still in the very early stages [10, 42] and should be developed further [35].

However, this article argues that governance takes place on organizational and technological levels and should be considered holistically. On an organizational level, blockchain can support processes of governance (“governance by blockchain”), whereas the operation of blockchain technology itself requires adequate governance on the technological side (“governance of blockchain”) [10, 11].

Being an institutional technology of governance [42, 43], blockchain could pave the way for a redesign of organizational processes, roles, and responsibilities since it could significantly reduce the number of intermediaries [41]. The support of bilateral modes of working requires a new self-conception of the PA contribution to direct and customized interaction between stakeholders. Public and non-public stakeholders could benefit from this institutional technology, as trust could be restored, coordination efforts improved, and costs of administration lowered [43]. Nonetheless, governance cannot be entirely covered by blockchain, such as with respect to dispute resolution or negotiations [10, 35]. The alignment of multiple governance procedures may consequently become essential. Brinkmann and Heine [10] demonstrate these functional overlaps and gaps with their conceptual work on matching up the technology of blockchain and the paradigm of NPG. The comparison of these two concepts proves that, theoretically, the functional match increases on an operational level and decreases on the strategic level of a public service delivery system.

Governance-related decisions regarding technology such as blockchain can directly impact the organizational layout [11]. Understanding the relationships of the architectural elements of data, application, and infrastructure to the organization is crucial to successfully creating an effective concept of institutional governance. And it seems necessary to assume that multiple parties would be part of the decentralized development and operation of a blockchain network, not only to support the original vision of blockchain but also because competencies in this field are already scattered, reflecting the different levels of experience and interests of those parties. Thus, governance of blockchain implies proper management along the whole technology lifecycle, such as ownership or responsibilities for development [11, 16]. If the ICT infrastructure of a decentralized public service delivery system were owned by only a few actors, they would have both great responsibility and the power to intentionally or unintentionally impact non-technical matters. Therefore, creating an accepted governance model for all involved parties is mandatory.

3 METHODOLOGY

This section presents the research design and thus introduces the method leveraged to empirically assess whether the functional expectations for NPG match with the outcomes of the reviewed projects. Two important factors can be derived from this question that significantly influence the research design—first, asking whether NPG played a role in the design of blockchain implementations, which indicates an X-centered focus (i.e., the attempt to better understand the influence of an independent variable on a dependent variable) [44, 45], and second, this question seeks to understand the project results as they represent the manifestation of design considerations of a blockchain implementation project.

Taking into account the explorative nature of this empirical research and the fact that blockchain technology is comparatively new, the author chose to conduct a qualitative small-N analysis [44] to further explore this object of research [46, 47]. Data would be gathered from interviews with project representatives. The steps listed next were then followed to achieve the goal of this research.

The aim of the first step was to define an adequate analysis framework. The foundation of this analysis is the “logical framework method for defining project success” [48], which was adjusted to fit the purpose of this research. Although the author does not want to decide whether a blockchain project is successful, this framework nonetheless provides useful dimensions and corresponding questions on how to appraise project value. It is assumed that (implicitly) considering NPG cannot only be assessed by the degree of covered requirements and system functionalities. Instead, the achieved purpose of the system and the underlying goals of the project also provide important indicators as to the importance of NPG. It can be assumed that NPG is most important

Table 2. Structure of the Expectation Analysis Framework and Expectations for NPG Coverage

Dimension [48]	NPG-Related Interpretation	Potential Expectations for NPG Coverage
Output	Does this BC solution cover the functional requirements related to NPG core elements?	<ul style="list-style-type: none"> • Enable co-producing network • Consider user voluntariness • Concept for interorganizational governance, including aspects of blockchain governance • Contracting between actors • Handle informal processes
Goal	Does this BC solution provide NPG-related qualitative and quantitative improvements to the in-scope public service?	<ul style="list-style-type: none"> • Efficiency gains (e.g., cost) • Increase customization of public services • Decrease coordination effort between actors • (Re-)Arrange roles and responsibilities
Purpose	Does this BC solution provide benefits to the PA's assumed NPG-related mission?	<ul style="list-style-type: none"> • Strengthen relationship with citizens or businesses • Increase trust in PA • Stronger leverage of non-public resources • Increase quality of public service • Increase perception of equality between public and non-public actors

to a project when the project meets the dimension expectations associated with NPG. Table 2 illustrates this expectation analysis framework.

It is worth noting that there is a fourth dimension, “Input,” within the framework of Baccarini [48]. This dimension is considered out of scope because it would involve factors such as the course of the project or stakeholder involvement during the project [48, 49], which would not add value to the result-oriented analysis of this article.

Step two of the methodology covered the identification of suitable public blockchain projects. To achieve this, broad internet research was conducted between August and October 2019 to find blockchain implementations by PAs around the world. This included the use of search engines, the analysis of databases (e.g., the “Blockchain in Government Tracker” by The Illinois Blockchain Initiative [12]), PAs’ press releases, and public records (e.g., Pignatelli et al. [50] and the European Union Blockchain Observatory and Forum [51]). The use of multiple sources supported the validation of project information [52] because it allowed for identifying inconsistencies or outdated data and closing information gaps. The projects found were then brought together and short listed based on two major considerations for suitability:

- First, blockchain projects were perceived suitable when at least one governmental process implementation was in scope. In contrast, blockchain projects were treated as not suitable when they focused on theoretical, conceptual, or strategy work (technology standards, legislation, or country strategies) or the introduction of cryptocurrencies.
- Second, a blockchain project was further considered suitable when its status was at least advanced by the time of the aspired interview, such as having pilot status or a mature proof of concept. Thus, only those projects are to be examined more closely that have probably already been able to gain significant practical experience.

For the identification of suitable blockchain projects, 211 public blockchain projects all over the world were found and analyzed, and 32 were deemed suitable for the article’s research objective (see the project overview

Table 3. Overview of In-Scope Blockchain Implementation Projects

Characteristic	Project 1	Project 2	Project 3
Project location	Malta, Europe	Zug, Switzerland, Europe	Sweden, Europe
PA in scope	Ministry for Education and Employment	City of Zug	Swedish Mapping, Cadastral and Land Registration Authority
Level of administration	National	Local	National
Relevant public service	Issue and authentication of education credentials	Proof of residency (eID)	Transfer of land titles
Use case description	<ul style="list-style-type: none"> • Blockchain-based educational certificate issued by PA • Citizen indicates hash code of certificate when needed • Third party can check hash code if indicated certificate is valid 	<ul style="list-style-type: none"> • Citizens request blockchain-based identity (eID) • Citizen and PA register eID • Citizen can then use this eID as authentication for public and non-public services 	<ul style="list-style-type: none"> • Blockchain is used as a platform to securely store the process status of land title transfers • Process workflow is executed off-chain on separate component
Blockchain configuration	Public permissionless	Public permissionless	Private permissioned
Source code	Open source	Open source	Proprietary
Project status	Pilot	Pilot	Proof of concept

provided as supplemental material along with this article). Once suitable candidates had been identified, an interview request was sent via email to contacts identified via further internet research. If a contact did not respond to the initial email, reminders were sent to them. In the end, out of those 32, three project representatives replied and agreed to participate in this interview. Twenty-nine contacts did not reply at all, declined an interview, or did not get back to the author for further information, although promised to do so. The project representatives were key stakeholders of their project and involved at a strategic level. The gathered information of the three selected projects were later validated during the interviews by considering relevant questions in the questionnaire to ensure an accurate project summary. An overview of the 211 analyzed blockchain projects is added as supplemental material to this article.

Due to the low number of projects, the results cannot be considered representative. However, a small-N case study can provide valuable explorative findings [45]. Table 3 introduces the three projects that participated in these interviews. The three projects show different characteristics and thereby offer a wider field to extract findings from. Especially, the proprietary and private nature of one solution may offer the chance to implement functions differently. In addition, local PAs rather show a more intense citizen contact than administrations at a national level. However, all three projects have in common that they are not in production and are, at best, in pilot status. In fact, research has shown that this is what similar public sector blockchain implementations around the world mostly have in common. As a consequence, the projects cannot benefit from much in the way of specific previous experience. Because the three selected projects are located in Europe, this research offers the opportunity to gain deeper insights into the status quo and the challenges of the European blockchain project landscape.

The third step the methodology comprised the design of the questionnaire for an interview guide approach. Due to the explorative character of this research, a partially structured interview guide was designed [46]. Subject areas and corresponding open questions [53] were derived from the expectations detailed for each of the analysis framework's dimensions and complemented by a literature review for further details. In the end, the interview guide consisted of 23 questions asking, for example, about the motivation for the project, its effects on the role

Table 4. Overview of In-Scope Blockchain Implementation Projects

Characteristic	Project 1	Project 2	Project 3
Project location	Malta, Europe	Zug, Switzerland, Europe	Sweden, Europe
PA in scope	Ministry for Education and Employment	City of Zug	Swedish Mapping, Cadastral and Land Registration Authority
Interviewee role	Project incubator to the ministry at executive level	Public project owner at executive level	Chief Innovation Officer of PA
Number of interviews	1	1	1
Type of interview	Video call	Phone call	Video call
Language	English	German	English
Duration ^a	1:05 h	0:35 h	0:40 h

^aQuestionnaire is added as supplemental material to this article.

of citizens, or aspects of blockchain governance. To ensure a high-quality questionnaire, the questionnaire was pretested within the team of researchers and improved accordingly.

In step four, the interviews were conducted. Interviewees were given the choice of either an in-person interview at their current location, wherever in the world that might be, or a face-to-face interview via video call (Table 4).

All interviews were recorded, with the agreement of the interviewees. Each interview was transcribed, and answers were complemented with desk research to add additional information wherever possible.

In the fifth step, the interview outcomes were analyzed following a two-step approach. Basis for the analysis was a table consisting of the dimensions from the expectation framework (*y*-axis) and the NPG core elements (*x*-axis). First, the interviewees' statements and additional information from the desk research were then mapped against the designed table structure. The results of one project could also be compared to the other projects, allowing a cross-case analysis and the identification of regularities or differences, on the basis of which categories could be formed (advanced *x*-axis) [47, 54]. With the definition of the categories, the initial mapping of statements and additional information was rearranged to meet the more detailed table structure. Once the rearrangement was completed, an interpretation in the light of expectations was conducted to understand whether a statement or finding either provides evidence to confirm or reject the expectation was met. By doing so, it is possible to show comprehensively whether an expectation was met and how strong each NPG core element was considered to be per dimension.

4 RESULTS AND DISCUSSION

This section provides the results of the conducted interviews and puts them into perspective. The multiple results are first summarized in Table 5, then presented in greater detail.

The results are structured in line with the core elements of NPG. Thereby, the findings can be viewed in the light of this article's research question of whether NPG (i.e., its core elements) is identifiable within the blockchain projects. The detailed interview analysis is added as supplemental material to this article.

4.1 Voluntary Co-Producing Networks

The projects show that blockchain is leveraged to replace traditional centralized methods of verification. These blockchain-supported public services do not constitute a fundamental change toward an NPG-oriented system of public service delivery. However, due to the use of blockchain, the actual service execution of the respective public services became more decentralized for all three projects—that is, users of the blockchain solutions no

Table 5. Result Summary per NPG Core Element

NPG Core Element	Result Summary
Voluntary Co-Producing Networks	<ul style="list-style-type: none"> • Co-production hardly achieved • Independence of non-public actors for public service execution increased • Efficiency gains for public and non-public actors • A lack of regulation may limit further use of blockchain • Limited methods leveraged to incentivize actors
Intersorganizational Governance	<ul style="list-style-type: none"> • Traditional assignment of roles between public and non-public actors did not change significantly • Governance capacities of PA challenged due to blockchain governance complexities
Contracts and Trust-Based Management	<ul style="list-style-type: none"> • Contracting realized by combination of on- and off-chain components • Smart contracts of no importance • Informal processes continue to be handled off-chain

longer rely on the PAs as much as they used to in order to interact with other citizens, businesses, or PAs. For example, by leveraging the blockchain-based eID service, the citizens of Zug can directly engage with businesses and reliably prove their identity without actually contacting the responsible PA for every business transaction. This can be perceived as supporting the expectation that NPG facilitates co-production without PA involvement. Thereby, both public and non-public actors also achieve efficiency gains, such as by lowered administration costs [50] or the fact that it is no longer necessary to travel in person to the PA's offices. Surely, PAs should carefully weigh up why they are undertaking the laborious journey toward blockchain-based public services. But a strong emphasis on efficiency gains raises the question of whether these could be better achieved by focusing efforts on alternative forms of digital transformation in the public sector, especially with respect to service and data interoperability and "Once Only" initiatives, as proposed by the European Commission [55, 56]. The latter aim at more efficient data flows between and in PAs. In so doing, citizens should not have to disclose already known data more than once, leading to, for example, cost and time savings or improved service quality [56].

The projects' service execution benefits from blockchain's decentralized approach and actively supports a shift of data ownership from PA to citizens, as can be clearly observed within the Maltese and Swiss projects. Thus, citizens, in particular, can better control the use of their data. This could potentially result in an increasing level of trust, as expected for NPG, since non-public actors become responsible for managing their own data. In addition, the shift is a precondition for a direct exchange between actors of their own resources—in these cases' data. As expected for NPG [3], the resulting decreased dependence on PAs implies an increasing flexibility for non-public actors and reduced coordination effort on both sides. However, a larger shift of ownership cannot be conceived of by PAs at the moment, because this would, in general, require key stakeholders within PAs and governments to adopt a mindset open to the sharing of responsibility for public service delivery. Interestingly, all interviewees referred to the need for proper and aligned regulation, especially with respect to the GDPR. Existing regulation would leave too much room for interpretation and thereby carries the risk of unlawful behavior. Current regulation would also limit the potential ways in which PAs could interact with non-public actors. Thus, it restricts the blockchain design options and hinders the expansion of blockchain networks.

However, apart from the service execution, the service design cannot be considered as a part of the joint decision making since the major functional specifications were defined by the three PAs. This is because they either ensured the design activities remained internal or acknowledged that design decisions should remain the

responsibility of PAs. Consequently, it seems rather questionable to conclude that the three projects truly strengthened collaborative working modes with the introduction of blockchain. In fact, the projects reveal co-operative work because the involved actors conduct their activities rather separately [57].

In addition to co-production in NPG, the voluntary participation of non-public actors within co-production was also considered to a certain extent. Due to their public blockchain configuration, Malta and Zug were aware that citizen motivation was important for public acceptance of their solution. The approach to ensure participation, however, was focused on the use case and the usability of the technical solution (e.g., the users' mobile app) only. Furthermore, citizens will likely hesitate to use the blockchain-based solutions because the established process of the public services continue to exist and could be used instead. No other incentive could be identified that might further reduce the citizens' motivation to leverage a blockchain-based public service.

4.2 Interorganizational Governance

As stated in Section 4.1, the use of blockchain did not lead to an implementation of NPG in all areas of public service delivery but rather focused on the public service delivery. This perception can also be supported with respect to governance. With NPG, the traditional role of PA as decision maker would change in favor of joint decision making, and resources from various actors would be combined to deliver public services. The interviewees shared the belief that their traditional mode of working would not change dramatically with the implementation of blockchain. In fact, the PAs made sure that deciding on changes to the public service or the blockchain solution remained within their remit. This was explained by the role of PAs as trusted entities, the need for strong leadership, and by the PAs' responsibility for the development and quality of public services.

With the use of blockchain, the development of and changes to public services are substantial, in terms of technology. Thus, the governance of a public service should also involve the governance of blockchain. But the governance of blockchain technology represents a substantial challenge, as outlined by the interviewees. Who should decide on changes to the technology? Who would be responsible for any wrongdoing? This summarizes the two major questions gathered during the interviews and still requires an answer. This issue was one reason the Swedish project chose to go for a private, proprietary blockchain solution, as it can thereby better define the governance procedures for its blockchain solution. Consequently, open blockchain solutions, such as running on the Bitcoin or Ethereum networks, may be harder to control. Accordingly, the Zug project stipulated rules and responsibilities for the external provider. Nonetheless, contractual agreements cannot cover all eventualities when open blockchain solutions are used. The interviewee from the Zug project also referred to acceptance issues among non-public actors (e.g., due to the technical complexity of this externally developed solution or uncertain terms and conditions of the solution provider). Thus, the introduction of blockchain for the benefit of NPG could actually decrease governance capacities to prevent an unfavorable solution development for governments and increase complexity instead due to the multiple involved actors on a technical level outside the public sector domain.

As a result, the Maltese and Swedish projects made a case for an overarching regulatory framework that could define the roles and responsibilities of public blockchain solutions and of blockchain solution providers in general. The European Blockchain Partnership was named as a good example of a facilitator on a European level. This demand for a joint regulatory framework seems appropriate to drive large-scale or interconnected blockchain solutions and thereby improve the impact of blockchain-based public services in terms of NPG. In fact, standardized blockchain solutions that could also speed up the spread of blockchain may only be accepted once proper regulation is in place. Last but not least, that joint regulatory framework would provide a promising opportunity to support blockchain users and solution providers to cope with the existing privacy and GDPR concerns.

4.3 Contracting and Trust-Based Management

Contracting represents formal types of interaction within NPG, whereas trust-based procedures rely on informal methods. For contracting purposes, blockchain offers the use of smart contracts to enforce the execution

of upfront-coded transactions, which could include legal contracts, for example. The interviews showed that contracting in general only plays a significant role in the Swedish project, due to its importance for the buying and selling of land titles. But smart contracts, in particular, are not important at all for any of the projects. The Swedish project developed a contract engine that handles all land title-related contracts off-chain, with only the confirmation of a contract being stored on-chain [58]. So, although the contracting is primarily not implemented via blockchain, it is the combination of on-chain and off-chain components that supports bilateral contracting without government involvement, as expected for NPG.

In addition, according to the three interviewees, informal processes are expected to be required within a blockchain-based public service delivery system. The projects' use cases, however, did not attempt to implement informal processes via blockchain. Those processes, such as legal counseling or discretion for decision making, remained outside the blockchain. There is no evidence that the handling of informal processes has changed because of a blockchain implementation. This is not surprising since blockchain depends on upfront-coded transactions. Spontaneous and flexible human behavior could hardly be supported by blockchain alone, if this behavior is not covered by the coded rules of the blockchain solution. This may require additional technologies, such as artificial intelligence, to facilitate the automated decision-making process and thereby increase the flexibility of a blockchain system. If informal processes remain in place (i.e., outside the blockchain solution), the three PAs in scope of this analysis should carefully evaluate and design their decision-making processes and elaborate the interfaces of the formal and informal processes to avoid premature decisions to be put on blockchain.

5 CONCLUSION

The research presented within this article aimed to identify the relevance of the NPG paradigm to the design of public blockchain solutions. The analysis of the projects shows that blockchain-based public service delivery partly meets the various expectations associated with NPG.

First of all, dependence on three PAs for service execution decreases, largely due to the shift of ownership toward non-public actors. This increases the flexibility of those actors and leads to relatively decentralized service execution. Efficiency improvements on both the public and non-public side, as well as trust gains for non-public actors, can be realized. Nonetheless, it was shown that a blockchain implementation does not necessarily involve any additional leverage of non-public resources. Strategy and design activities, in particular, remained core responsibilities of the analyzed PAs. With respect to the investigated projects, public and non-public actors did not jointly decide on strategy or design matters for public service delivery in the sense of NPG.

Second, it can be concluded that the reviewed PAs did not intend to become “one player amongst many others” [27] because they continue to believe in the key responsibility of PAs to guarantee trusted public services. Despite the question of whether NPG could be realized with blockchain, it should be noted that it can hardly be assumed that NPG is currently being implemented within the three PAs. Hence, the realization of NPG could become even more challenging for the PAs with blockchain. With a growing number of stakeholders, governance efforts are likely to increase since there are multiple stakeholders involved at a technical level. It shows that the challenge faced by the PAs in retaining their digital sovereignty is to keep “full knowledge and control... about who can access ones data and where ones data are transferred” [59]. Accordingly, the reviewed PAs call for a regulatory framework that sets binding roles and responsibilities for all parties, including international ones. In addition, the shared responsibilities in the Zug and Malta projects, where non-public ICT providers mainly allocate their ICT infrastructure capacities utilized by the PAs, bears the hallmark of the government-as-a-platform concept [60].

And third, the interviews showed that smart contracts alone seem to play only a limited role in today's projects. Instead, it was the combination of on-chain and off-chain components that ensured expectations regarding NPG and contracting could be met. However, the projects' results also demonstrated that public services did not become less or more informal due to the use of blockchain.

There are also limitations to the results of this research. It is not feasible to claim that the results are representative, as only three early-stage projects were involved in the review. Nonetheless, it was reasonable to strive

for an explanatory approach since blockchain is a relatively new technology and because it was being combined in an innovative way with the promising NPG paradigm.

The results of this research offer multiple opportunities for further research. For each analyzed use case (i.e., transfer of land titles, issue/authentication of education credentials, and proof of residency), the results could be compared with similar blockchain implementations in other regions. Understanding the different implementations of the same use case, offers the chance to derive, for example, best practice or common issues in the area of blockchain governance and thereby enhances this article's results. Especially with respect to the Swiss use case on proof of residency, it seems useful to further connect this with ongoing efforts of the European Union toward a European Self-Sovereign Identity Framework as part of the European Blockchain Services Infrastructure [61]. A strong connect between national and international activities may be beneficial for both parties in terms of efficiency and knowledge sharing. International activities, in particular, rely on insights from country level to support technological adoption and user acceptance of potential future solutions.

In addition, the concept of NPG may be fruitful for the relatively new scientific community that is forming around blockchain. Following the scientific discussions on and challenges faced by concepts such as NPG could offer insight into the challenges of usefully implementing blockchain [9]. For example, what future skillset will be required in public servants who are expected to work in a collaborative manner? This issue was raised by the Maltese interviewee, and considering existing research from PA scholars may help to address it [62]. At the same time, blockchain offers great potential for process integration. Hence, it seems worth investigating whether the NPG paradigm with its emphasis on decentralized public service delivery could be further enhanced by the technology-enabled integration mechanisms [63] of blockchain or other distributed ledger technologies.

As well, comprehensive approaches to blockchain governance are required to allow PAs to master the increased complexity of governance brought about by the use of blockchain. Without a convincing, multi-stakeholder approach, NPG or blockchain may very well not proliferate as hoped by blockchain enthusiasts. This also applies to ongoing discussions around the compatibility of blockchain and GDPR [64], which could now be extended. It also may be useful to repeat this kind of research once there are public sector blockchain solutions that have been in production for some time to see how the public service develops over time and what decisions were taken to answer the questions raised in this article.

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